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# THE UNITED STATES OF AMERICA

**TO ALL TO WHOM THESE PRESENTS SHALL COME:**

**UNITED STATES DEPARTMENT OF COMMERCE  
United States Patent and Trademark Office**

**March 03, 2001**

**THIS IS TO CERTIFY THAT ANNEXED HERETO IS A TRUE COPY FROM  
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APPLICATION THAT MET THE REQUIREMENTS TO BE GRANTED A  
FILING DATE UNDER 35 USC 111.**

**APPLICATION NUMBER: 60/177,695  
FILING DATE: January 24, 2000  
PCT APPLICATION NUMBER: PCT/US01/02331**

**By Authority of the  
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*W. Montgomery*  
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Certifying Officer

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# PROVISIONAL APPLICATION FOR PATENT COVER SHEET

This is a request for filing a PROVISIONAL APPLICATION FOR PATENT under 37 CFR 1.53 (b)(2).

*Alpro*

01/24/00

60177695-012400

60177695-01/24/00

Docket Number		Type a plus sign (+) inside this box -->	
INVENTOR(s)/APPLICANT(s)			
LAST NAME	FIRST NAME	MIDDLE NAME/INITIAL	RESIDENCE (CITY AND EITHER STATE OR FOREIGN COUNTRY)
HOU	ZEZHANG		852 Bette Ave. Cupertino, CA 95014
TITLE OF THE INVENTION (280 characters max)			
Remote Hearing Test			
CORRESPONDENCE ADDRESS (including country if not United States)			
Zezhang Hou 852 Bette Ave. Cupertino, CA 95014			
ENCLOSED APPLICATION PARTS (check all that apply)			
<input checked="" type="checkbox"/> Specification	Number of Pages	4	<input checked="" type="checkbox"/> Small Entity Statement
<input checked="" type="checkbox"/> Drawing(s)	Number of Sheets	1	<input type="checkbox"/> Other (specify) _____
METHOD OF PAYMENT OF FILING FEES FOR THIS PROVISIONAL APPLICATION FOR PATENT (check one)			
<input checked="" type="checkbox"/> A check or money order is enclosed to cover the filing fees	FILING FEE AMOUNT (\$)		
<input type="checkbox"/> The Commissioner is hereby authorized to charge filing fees and credit Deposit Account Number: _____			

The invention was made by an agency of the United States Government or under a contract with an agency of the United States Government

☒ No

☐ Yes, the name of the U.S. Government agency and the Government contract number are \_\_\_\_\_

Respectfully submitted,

SIGNATURE

*Zezhang Hou*

Date

1/16/00

TYPED or PRINTED NAME

ZEZHANG HOU

REGISTRATION NO.  
(if appropriate)

\_\_\_\_\_

☐

Additional inventors are being named on separately numbered sheets attached hereto

**USE ONLY FOR FILING A PROVISIONAL APPLICATION FOR PATENT**

Mail January 17, 2000

Box Provisional Patent Application  
Assistant Commissioner for Patent  
Washington, DC 20231


Dear Sir,

Enclosed please find the following papers for provisional patent applications:

- (1) Provisional patent application cover sheet.  
Applicant: Zezhang Hou  
Title: Remote Hearing Test
- (2) Specification/Drawing: five pages.
- (3) Small Entity Declaration of Inventors
- (4) Check for \$75.00
- (5) Return Receipt Postcard Addressed to Applicant.

Best Regards,

Applicant

  
Zezhang Hou  
852 Bette Ave.  
Cupertino, CA 95014

The PTO did not receive the following  
list of item(s) A CHECK OF \$75.00

60177555.012400

**VERIFIED STATEMENT CLAIMING SMALL ENTITY STATUS  
(37 CFR 1.9(f) & 1.27(b))--INDEPENDENT INVENTOR**

Docket Number (Optional)

Applicant or Patentee: ZEZHANG HOU

Application or Patent No.: \_\_\_\_\_

Filed or Issued: 1-16-00

Title: Remote Hearing Test

As a below named inventor, I hereby declare that I qualify as an independent inventor as defined in 37 CFR 1.9(c) for purposes of paying reduced fees to the Patent and Trademark Office described in:

- ☒ the specification filed herewith with title as listed above.  
☒ the application identified above.  
☒ the patent identified above.

I have not assigned, granted, conveyed or licensed and am under no obligation under contract or law to assign, grant, convey or license; any rights in the invention to any person who would not qualify as an independent inventor under 37 CFR 1.9(c) if that person had made the invention, or to any concern which would not qualify as a small business / concern under 37 CFR 1.9(d) or a nonprofit organization under 37 CFR 1.9(e).

Each person, concern or organization to which I have assigned, granted, conveyed, or licensed or am under an obligation under contract or law to assign, grant, convey, or license any rights in the invention is listed below:

- ☒ No such person, concern, or organization exists.  
☐ Each such person, concern or organization is listed below.

Separate verified statements are required from each named person, concern or organization having rights to the invention averring to their status as small entities. (37 CFR 1.27)

I acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate. (37 CFR 1.28(b))

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application, any patent issuing thereon, or any patent to which this verified statement is directed.

ZEZHANG HOU

NAME OF INVENTOR

NAME OF INVENTOR

NAME OF INVENTOR

Ze Zhang Hou

Signature of inventor

Signature of inventor

Signature of inventor

1-16-2000

Date

Date

Date

## Remote Hearing Test Zezhang Hou

### Abstract

An invention for testing hearing loss over the modern communication media such as Internet and telephone networks described.

### Introduction

About 10% of human population experience some degree of hearing loss. Only 25% of those who have hearing loss wear hearing aids. The stigma, cost, and availability have been considered as the major factors for preventing the wide use of the hearing aids. Many people don't want to wear hearing aids because they see the hearing aid as a symbol of disability. For people who can overcome the stigma obstacle, cost may be a big issue. Conventionally, one has to go through a series of tests before getting his impaired ear(s) fitted with hearing aids. These tests and hearing aids together usually cost much more than a TV with premium quality. Yet, many other people don't know they have hearing loss although they may experience some difficulties in hearing. They don't know because they may be reluctant to spend time and money to have their hearing checked. In many countries including US hearing specialists such as audiologists perform diagnosis of hearing loss. Some other people may clearly know they has hearing loss but are not able to get help because a hearing specialist's office is too far from his home or they may simply don't know where to get helps. This problem is very common in many developing countries.

In most developed countries, hearing loss is diagnosed using an a special equipment called audiometer. Typically, a patient must visit a hearing specialist's office or an ENT doctor's office to do the test. If a hearing loss is diagnosed, the specialists or doctor wills council the patient to consider using hearing aid. If the patient choose to get one, the specialist or doctor has to spend additional time to fit the hearing aid for the patient. All these services are expensive if they are not covered by insurance or government, as it the case for most patients in US.

When testing hearing loss using an audiometer, a calibrated pure tone signal will be presented to patient via a transducer such as headphone, insert earphone, or loud speaker to one of the patient's two ears. If the patient hears the tone, the level of the tone will be reduced and presented to the patient again. If the patient can not hear the tone, the level of the tone will be decreased and presented to patient again. This procedure will repeat many times until certain number of reversals from decreasing the tone to increasing the tone is reached. Hearing threshold of the patient is defined as the signal level at which the patient can hear the tone 50% percent of the times the tone is presented. This threshold can be derived from the reversal levels. For each ear, the above procedure is usually repeated at 125, 250, 500, 1000, 2000, 4000, and 8000 Hz. If the difference of the thresholds at the two adjacent frequencies exceeds a critical value (e.g., 20 dB) an additional test is done at a middle frequency. This rule applies for frequencies from 500 to 8000. Therefore, the maximum number of testing frequencies is usually 11 (125, 250, 500, 750, 1500, 2000, 3000, 4000, 6000, and 8000 Hz).

In order for the test results to be meaningful, the testing system must be calibrated. In other words, we must know the relationship between the electrical settings in the system and the acoustical pressure to be delivered to subjects. The components affecting the calibration including, but not limited to, electrical system that generates the stimuli and listening system (transducer) that converts electrical signal into acoustic pressure. The problem is complicated by the fact that sound level measured at the eardrum of human varies from person to person even it is delivered with the same system and setting. Because of this, a testing system is usually calibrated using a special coupler for which a reference hearing level of normal listeners has been established. For example, the audiometer with an insertion earphone is usually calibrated in a 2cc coupler. When listeners with normal hearing listen to pure tones through an insertion earphone, the sound levels, as measured in the 2cc coupler, of the pure tones need to be set to the followings for the sounds to be just audible:

Frequency (Hz)	Level (dB SPL)
125	45
250	35
500	20
750	15
1000	10
1500	8
2000	7
3000	12
4000	20
6000	27
8000	30

The above levels are called normal reference levels of the insertion earphone in the 2cc coupler. The reference levels vary for different transducers as well as different couplers.

Hearing threshold for a patient is usually expressed in dB HL, which is a relative level in reference to the normal reference levels. The reference levels should have been established for the system and transducer used in the test. For example, the normal reference level for an insertion earphone is 7 dB SPL at 1kHz as measured in a 2cc coupler. If the hearing level for a patient is 47 dB SPL at the same frequency as measured in the same 2 cc coupler, the hearing loss for the patient is  $47-7 = 40$  dB HL. For most commercial audiometers, the normal reference levels are built in the machine, and the signal level presented to patient is automatically expressed in dB HL. There are two advantages by doing this. The first one is that users don't have to make additional calculation and the second is that the threshold is already in dB HL which is independent of transducer used in the test.

While testing hearing loss using an audiometer has had a long history, no one has ever tried to test hearing using an electronic network such as telephone or Internet system. In fact, it has been thought impossible because commercial telephone or personal computers used for the Internet are not calibrated, which is critical for the test to be meaningful. An innovative methods are clearly needed.

### Summary of the invention

This invention provides a method for testing hearing over an electrical or communication network such as telephone or Internet system. No special setup other than standard network access equipment such as telephone or computer is required. No special engineering calibration is needed for the testing system. With this method, a user can get his/her hearing checked tested at a place such as home, other than hearing specialist or doctor's office.

The key element of the invention is that the reference threshold level for the hearing testing system is established using one or a few subjects whose hearing are known or normal. The procedure for establishing the reference is part of the testing, as opposed the conventional method in which the reference is established by manufactures or standard committees when the systems are built up. The testing for establishing the reference can be done either before or after the target subject is tested. The hearing thresholds for the target subject is determined from the differences of the hearing levels as measured by the underlining test system between the target subject and the reference subject(s), plus the hearing threshold of the reference subject(s). If the reference subject(s) has(ve) normal hearing, the difference is the hearing threshold of the target subject.

Figures 1 and 2 show how a hearing loss can be tested via a Web page on the Internet. A hearing test starts with a click on "Start" and then proceeds with clicks of "RespYes" or "RespNo" depending on if the listener hears the presented sound or not. The test is firstly done for a reference subject (Figure 1) and then for patient subject (Figure 2). The results for the reference subject are shown on the row labeled as "Reference (dB)" and results for the patient subject are shown on the rows labeled as "Threshold (Left, dB

HL)" or "Threshold (Right, dB HL)". A test can be a reference test or diagnostic test depending on which radio button, "Reference" or " Subject", is checked.

In one preferred embodiment, the hearing test is done via Internet. A testing program is stored in a center computer of a company and can be accessed by users visiting the company's Web Page or logging in onto the center computer. A user can either run the program off the center computer or download the program into his/her local computer and run the program off the local machine. In either case, the program will generate sounds off the local machine that will present the sounds to the patient ear(s) via either earphone or loud speaker. The program will be able to decrease or increase the sound level based on user's response to the previously presented sound. The sound could be pure tone or pulsed pure tone at any frequency, could be noise or noise burst with any center frequency. A test session involves at least two people. Results for at least one person whose hearing is known (or known as having a normal hearing level) are used as the reference. The hearing levels of the target subject(s) in relative to the reference define the target subject(s) hearing loss. The advantage of introducing the reference test is that the testing system does not have to be calibrated, which is actually impossible if the test system involves Internet, and that users don't have to buy any additional hardware. The only requirements for such a test are that users have a computer with a sound card and a headset earphone, and are able to establish the communication between his computer and the center computer.

In another preferred embodiment, the hearing test is done via Telephone system. A testing program is stored in a machine or a center computer owned by a company and users can access the program through telephone line. Users call the center machine or computer and optionally input some information to activate the program. The program will generate sounds off the center machine and present the sounds to the user's ear(s) via patient telephone. The program will be able to decrease or increase the sound level based on patient's response to the previously presented sound. The sound could be pure tone or pulsed pure tone at any frequency, could be noise or noise burst with any center frequency. A test session involves at least two people. Results for at least one person whose hearing is known (or known as having a normal hearing level) are used as the reference. The hearing levels of the target subject(s) in relative to the reference define the target subject(s) hearing loss. The advantage of introducing the reference test is that the testing system does not have to be calibrated, which is actually impossible if the test system involves telephone line, and that users don't have to buy any additional hardware. The only requirements for such test are that the user has a telephone with a sound deliver system such as handset, and is able to activate the program in the center machine through his telephone.

In another preferred embodiment, the reference is established once and used for many test sessions until the hardware settings of the test system are changed. Change of the volume wheel on a speaker, headphone, telephone, or other transducers, change of computer hardware, telephone line, or telephone set, and etc. are regarded as the change of hardware setting and a new reference must be established for the new setting.

### Claims:

We claim:

1. A method of doing hearing test via a communication network involves:
  - Finding reference hearing threshold levels at a plural of frequencies for one or a plural of reference listeners;
  - Without changing the hardware settings of the test system, finding target hearing threshold levels at a plural of frequencies for one or a plural of target listeners;
  - Determine hearing losses at a plural of frequencies for the target listeners from the reference hearing threshold levels and the target hearing threshold levels.
2. The method within claim 1, whereas the communication network is Internet;
3. The method within claim 1, whereas the communication network is Telephone network;
4. The method within claim 1, whereas the communication network is cable television network;
5. The method within claim 1, whereas the communication network is wireless television network;
6. The method within claim 1, whereas the communication network is Web TV network;



7. The method within claim 1, whereas the reference listener or listeners have normal hearing.
8. The method within claim 1, whereas the hearing losses for the reference listener or listeners are known.
9. The method within claim 1, whereas the reference hearing threshold levels are obtained by combining the individual hearing threshold levels for one or a plural of listeners whose hearing are known or who have normal hearing.
10. The method within claim 9, whereas the reference hearing threshold levels are further corrected using the known hearing losses of the reference listeners
11. The method within claim 1, whereas the hearing threshold levels are in a decibel scale.
12. The method within claim 11, whereas the reference number of the decibel scale is an arbitrary number.
13. The method within claim 11, whereas the reference number of the decibel scale is a fixed number.
14. The method within claim 1, whereas the hearing threshold levels are in a scale proportional to decibel.
15. The method within claim 14, whereas the reference number of the scale is an arbitrary number.
16. The method within claim 14, whereas the reference number of the scale is a fixed number.
17. The method within claim 1, whereas the hearing threshold levels are in a scale proportional to voltage;
18. The method within claim 1, whereas the reference hearing threshold levels are found first.
19. The method within claim 1, whereas the target hearing threshold levels are found first.
20. The method within claim 1, whereas the hearing losses for each target listeners are determined by subtracting the reference hearing threshold levels in decibels from the target hearing threshold levels in decibels for the same target listener.
21. The method within claim 20, whereas the hearing losses are further corrected by the hearing losses of the reference listeners.
22. The method within claim 1, whereas the hearing losses for each target listener are obtained dividing the target hearing threshold levels for the same target listener by the reference hearing threshold level.
23. The method within claim 22, whereas the hearing losses for each target listener are further corrected by the known hearing losses of the reference listeners.
24. A method of doing hearing test via a communication network:  
The program for controlling the test is located in a central machine in a central office.
25. A method within claim 24, whereas the program is run directly off the central machine.
26. A method within claim 24, whereas the program is downloaded from the central machine into a local machine and run from the local machine.
27. A method within claim 24, whereas the central machine is a computer.

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TestID - Microsoft Internet Explorer provided by America Online

On-Line Hearing Test

Subject: ☐ Reference ☒ Subject

Test Ear(s): ☐ Left ☐ Right ☒ Both

Test Frequency (Hz): ☒ 250 ☐ 500 ☐ 750 ☐ 1000 ☐ 1500 ☐ 2000 ☐ 3000 ☐ 4000 ☐ 6000 ☐ 8000 ☐ All

Reference (dB)	40	35	35	35	35	35	35	35	35	35
Threshold (Left, dB HL)	20	25	30	40	50	60	70	80	80	80
Threshold (Right, dB HL)	30	30	30	40	45	58	70	75	75	80

Figure 1. Hearing test via Internet. Step 1: Establish reference hearing levels for the testing computer using a normal hearing subject.

TestID - Microsoft Internet Explorer provided by America Online

On-Line Hearing Test

Subject: ☒ Reference ☐ Subject

Test Ear(s): ☐ Left ☐ Right ☒ Both

Test Frequency (Hz): ☒ 250 ☐ 500 ☐ 750 ☐ 1000 ☐ 1500 ☐ 2000 ☐ 3000 ☐ 4000 ☐ 6000 ☐ 8000 ☐ All

Reference (dB)	40	35	35	35	35	35	35	35	35	35
Threshold (Left, dB HL)										
Threshold (Right, dB HL)										

Figure 2. Hearing test via Internet. Step 2: Find hearing loss for the patient subject.

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